

humaine

D3l: Final report on WP3

Workpackage 3 Deliverable



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1 The place of this report within HUMAINE

The final workpackage reports in HUMAINE have been designed as brief statements that complement other sources. On one hand, substantive content – particularly technical content – has been reported in deliverables throughout the project. On the other hand, several potentially overlapping sources are part of the final reporting process. In particular, the activity report for the final period sets out the goals achieved during the final period; and the final report for the project as a whole includes a relatively non-technical account of what the workpackage has achieved.

This core of this report is shared with the section on WP3 in the final report for the project as a whole. That consists of a short, non-technical summary of what the workpackage has achieved. However, there are details that do not belong in a report intended for the general reader (such as information about the participating institutions, meetings organised, etc). They are covered here.

Workpackage members invested a substantial amount of effort in the deliverables, and they form a continuing resource available to the community on the HUMAINE portal. They are listed for completeness. In some senses it would make sense to do the same for publications, but they are too difficult to allocate to individual workpackages. A full list is given in the final report for the project as a whole.

2 Workpackage remit, membership and structure

The HUMAINE project was created to lay the foundations for European development of systems that can register, model and/or influence human emotional and emotion-related states and processes – ‘emotion-oriented systems’. Emotion-oriented systems are systems which relate to, arise from, or deliberately influence emotions. The ambition to create such systems is commonly addressed by multi-modal platforms which express, perceive, feel and respond to emotional components of their environment. The exponentially blooming technological landscape will leave us with no choice but to create a productive link between man and machine. With this in mind, it is important to take into account what defines emotions in ourselves so as to create the perfect interface with the machine: psychology meets the engineering sciences.

Work Package (WP) 3 of the HUMAINE project is entitled ‘Theory and Models’. Its general goal has been to develop the connection between psychology and the engineering sciences referred to above. This report summarizes the activities and achievements of WP 3 during its years of operation 2004-2007.

Project partners in WP3 were:

- University of Geneva (UNIGE) (lead)
- Queen’s University Belfast (QUB)
- [Deutsches Forschungszentrum für Künstliche Intelligenz GmbH, Saarbrücken](#) (DFKI)
- [Institute of Communication and Computer Systems - National Technical University of Athens](#) (ICCS)
- [University of Hertfordshire](#) (UH)
- [Université Paris-VIII](#) (Paris 8)
- [Österreichische Studiengesellschaft für Kybernetik, Vienna](#) (OFAI)
- [Universität Augsburg](#) (UA)
- [Università Degli Studi di Bari](#) (BARI)
- [Friedrich-Alexander-Universität Erlangen-Nürnberg](#) (FAU)
- [University of Haifa](#) (HU)
- [Imperial College of Science, Technology and Medicine, London](#) (ICL)
- [Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento em Lisboa](#) (Inesc)
- [King's College, London](#) (KCL)
- [Centre National De La Recherche Scientifique, Paris](#) (CNRS)
- University of Oxford (UOXF)
- [University of Southern California](#) (USC)
- University of Manchester (MAN).

The Work Package was divided into three Work Groups (WGs). Each WG addressed specific issues, which have been agreed upon within the network, following earlier interactions:

- WG 1 focused on “Conceptual and terminological clarifications”
- WG 2 focused on “Emotion models and computational modelling”
- WG 3 focused on “Communication skills”.

Dissemination within the network was fundamental to WP3 in a way that was unlike any other WP. WP3 has had a role of consultancy on theories of emotion. Its goal has been to gather, describe, inform and advise other Work Packages of relevant emotion theories and models.

Its input in HUMAINE was mainly theoretical and ensured the biological and functional plausibility of implementation attempts of other WPs by setting a framework from which there could arise both a better understanding of emotional processes (theoretical outcomes) and better emotion-oriented systems (applied outcomes).

Even though there is an increasing interest in Affective Science, the field is still divided into numerous theories, concepts and models. There is still a huge amount of work to do before getting a comprehensive and widely accepted theory of emotion. Therefore, it has been the role of the WP3 to compile current emotion theories and introduce them to the HUMAINE community. Our goal was to establish a set of shared definitions, concepts, and a limited number of models for concrete applications. This input was, in turn, intended to allow the engineering-oriented groups to perfect their systems by integrating human-like emotional processes.

Specific areas of work were as follows:

- WP3 focused on consensual operational definitions; more generally it attempted to establish a common framework to allow the comparison of theories and models.
- WP3 also attempted to list specifications of working models. This input was intended to allow the identification/selection of specific models for specific purposes/applications.
- WP3 also proposed concrete ideas for implementation. These suggestions integrated fundamental knowledge about emotional processes in human beings into working simulations. This input is of use to both the Engineering and Psychology communities, being applied and implementation-oriented and allowing the study of the intrinsic features of emotion theories.
- Finally, WP3 contributed to the research community by providing means and tools to assess the different theories and working models of emotions.

WP3 has had a communicative role, and took an active part in the different projects organized by other WPs. It provided psychologically-driven inputs to more engineering-oriented groups. This role fell into two parts: on one hand, bringing together the research community and developing a cross-disciplinary dialogue on a common basis, and, on the other hand providing the tools which would allow such mutual understanding.

WP3 and HUMAINE, on a broader scale, have established strong ties with the newest research center in Affective Sciences: Geneva was awarded a National Competence Center for Research (NCCR) in Affective Sciences in late 2005, thus bringing to the HUMAINE community the most up-to-date insights in theoretical research on emotions. The NCCR is based at the University of Geneva and directed by Prof. Klaus Scherer, head of the Geneva Emotion Research Group. NCCR members represent the fields of anthropology, history, neurology, philosophy, psychology, law, religion and economics at five different Swiss universities. Over a period of up to 10 years, twelve individual projects will conduct research into how feelings are produced and perceived, how they are controlled, and what social functions they serve; jointly developing and applying advanced methods and instruments. Researchers will synthesize their findings, and in collaboration with partner institutions in politics, business, and health care, the NCCR will emphasize the applications of research results.

We now turn to the main achievements of WP3 during its period of operation 2004-2007.

3 Achievements in WP3

The aim of this section is to report what WP3 achieved rather than to record activity for its own sake. Achievements are divided into three main sections – empirical, internal communication, and publication.

3.1 Empirical

Achievement 1: The “Grid” Study

The aim of this study is to assess cross-cultural differences in the semantic profiles that are implicitly attributed by people when they use emotion terms. The rationale for this is that emotion terms are often used in different contexts. This being so, the intrinsic meaning of an emotion term varies on the basis of who uses it, when one uses it, or where. Building upon the work of contemporary emotion researchers, we constructed a questionnaire on the basis of a set of dimensions that are believed to describe the antecedents to the genesis of emotional experiences, and its consequences on the components of emotions (the appraisal component, the autonomic physiology component, the action tendency component, the expressive component, the subjective feeling component).

The research team began by constructing the questionnaire, and pre-testing it over a small subset of the emotion terms selected for comparison. A first version of the questionnaire was implemented into a web-based questionnaire, to assess the feasibility of the study. This first pre-test allowed us to modify the questionnaire, and a second version of it was used during the “Autumn Academy in Affective Sciences”, held in Geneva, October 2005. The results have been analyzed, and the knowledge gained from it has allowed us to launch the full study this year.

The results of this large-scale cross-cultural study, replicated across several languages, provide robust evidence showing that more than two dimensions are needed for a low-dimensional representation of emotion (figure 1). Our results suggest that the most important three dimensions are valence, potency, and arousal, in this order of importance. A fourth dimension, unpredictability, seems necessary to allow a satisfactory differentiation of emotions reflecting the important emotional quality of an urgent reaction to a novel or an unfamiliar situation.

The two hypotheses of the current research were confirmed, namely (1) that the denotative meaning of emotion words consists of their reference to componential emotion features and (2) that the overlap in denotative meaning between pairs of emotion words gives rise to a low dimensional similarity structure of emotion words. The confirmation of these two hypotheses offered the opportunity to further investigate the two research questions that are of central importance for both theory building and practical application of dimensional emotion theories, namely about (1) the number and (2) the kind of dimensions that underlie the emotion domain. As is found in meaning-oriented research based on similarities between emotion words, three main factors emerged. Moreover, a fourth – albeit smaller – factor emerged in three language groups. These factors could be interpreted as affiliation versus avoidance, dominance versus submissiveness, high versus low arousal, and sudden versus long-term emotion. The position of the emotion words on the three first factors reproduced the evaluation – potency – dominance structure that is found across cultural groups based on direct similarities between emotion words.

The specific contribution of the present study lies in the fact that it uncovers the underpinnings of the dimensional emotion structure. All previous research could be considered as surface

research. The structures were based on similarities between emotion words based on perceived overlap in meaning or overlap in self-descriptions of individuals, without knowing what precisely constituted the meaning or individual-difference overlap. The present study worked the other way round and started with a very clear theoretically grounded hypothesis about what emotion words mean and could then demonstrate that the same structures emerged on the basis of identified (denotative) meaning overlap. By demonstrating that four dimensions could reliably be found in three languages, and by further specifying the underlying features that constitute dimensions, we provided the research community in general, and the HUMAINE network in particular, with means of selectively use and adapt applied systems for each dimension.

The findings of the study so far have been published:

Fontaine, J. R., Scherer, K. R., Roesch, E. R., Ellsworth, P. (2007). The world of emotions is not two-dimensional. *Psychological Science*, 18(2), pp 1050-1057.

In addition to being published in one of the major journals in psychology, results of this research were presented at the 3rd HUMAINE Summer School, in Genoa, Italy, September 22-28, 2006. The audience attending the summer school was very broad, encompassing all the disciplines represented in the HUMAINE network, and gathering partners from all WPs. The presentation yielded very vivid discussions, and was thoroughly carried on after the event.

Follow up of the study includes translating the questionnaire into the languages of the HUMAINE partners, and organizing the participations of additional institutions. Results will be published, and disseminated within the network. We would like to acknowledge the participation and support of the following institutions, for translating the questionnaire into the HUMAINE languages, and providing participants to take the questionnaire: QUB, ÖFAI, NTUA, TAU, INESC/IST, DIST.

It is intended to extend the Grid study to a selection of the world's languages in the next few years. To this end, the International Consortium for Cross-Cultural Research on Affect (ICCRA) was founded in 2005. It is sponsored by the NCCR Affective Sciences at the University of Geneva. ICCRA is a new international network of researchers. Its aim is to encourage cross-cultural research on emotion with a principled approach based on the componential emotion theory. The ultimate goal of the GRID project is to create a world atlas of emotion terms. Emotion researchers from all over the world are invited to collaborate in this extensive research endeavour.

Achievement 2: Actuarial studies

One of the key intuitions behind HUMAINE is that emotion in its broad sense makes up a major part of human life. But although the idea that emotion pervades human life is one that people tend to accept automatically, there is not much formal evidence to support it. It is important for emotion-oriented computing to clarify the issue. The case for investing effort in the discipline depends on it, and so do more specific judgments about the importance of particular research topics within the area.

HUMAINE partners carried out a series of studies on these issues. They are reported in a deliverable, "Actuarial occurrence of affective phenomena" (D3j), and the main points are summarised here.

The word 'emotion' has a strong sense, referring to brief, intense episodes of well-defined types. The report uses the term 'emergent emotion' to distinguish that sense from other meanings of the word. Emergent emotion is probably not very common – some estimates

suggest that episodes occur about once a day, others that they occupy less than 10% of everyday life. On the other hand, life is rarely without any emotional colouring. That leaves a large part of life between the extremes – neither emotion in the strong sense, nor completely emotionless.

There is a lack of agreed terms to describe the states in between. HUMAINE studies developed a set of descriptions that non-experts appeared to find acceptable, and then used phone calls at random times to estimate how often the various states occurred. The table below summarises the findings.

Table 3.1.1 Summary of results from actuarial studies, giving proportion of reports (right hand column) in which the specified emotion-related states were reported.

Emotion-like		Established Emotion – an enduring feature of the way we relate to something or someone – eg sadness at a loss, anger at a policy	0.9%
		Emergent Emotion (full-blown) – the classic relatively brief, reactive episode.	1.5%
		Emergent Emotion (suppressed)	1.7%
Mood-like		Transitional emotion (shifting between mood and emergent emotion)	1.5%
		Mood - a generalised bias involving the positive/negative dimension of affect	36.1%
		Altered State of Arousal - a generalised bias involving the arousal dimension of affect	21.9%
		Altered State of Control - a generalised bias involving the sense of being in control or not on control of things	3.9%
Stance-like		Altered State of Caring - a generalised bias involving the sense of whether things or events particularly matter.	0.4%
		Stance towards object/situation (complex, relatively shortlived orientation towards things/ events involving emotional, cognitive and perhaps other elements)	25.6%
		Interpersonal Stance (complex, relatively shortlived orientation towards people involving emotional, cognitive and perhaps other elements)	2.4%
		Interpersonal Bond (complex, enduring state involving feeling about a person, disposition to act in certain ways towards him or her, and perhaps other elements).	4.1%
Emotionless			0.0%
None of the above			0.0%

Achievement 3: modes of interpersonal response to emotion

Research conducted in Oxford by Claudia Marinetti focused on the effect of different cognitive and social variables on emotional experience and facial behaviour, with a special focus on the Illusion of Transparency, a phenomenon for which people tend to overestimate the extent to which their emotions are readable by others who can see their faces. Among the variables that have been studied are attention focus, display rules, and social motives.

In an emotional situation, the focus of our attention can be directed inwardly, to our feelings, or externally, to people or to specific details in the situation. In order to assess if these different attention modes have an influence on emotional experience, participants have been asked to watch emotional film clips, while being video-recorded, and then complete a series of questionnaires containing, among others, items meant to measure Illusion of transparency, explicit awareness of subjective feelings, action tendencies, and bodily symptoms. Results have shown that while Illusion of Transparency does not seem to be affected by the attention mode, other components of the emotional experience are influenced by it. In particular, self-reports of bodily symptoms create a more homogeneous and coherent pattern when people are focusing on their own emotions than when they are focusing elsewhere during an emotional episode. To further investigate these findings, another experiment has been conducted with the same setting but stronger manipulation of the independent variables. Data from this study will be soon analysed.

Display rules represent the knowledge we have about what is appropriate and what is inappropriate to express in a certain situation (e.g. it is usually inappropriate to laugh at a funeral, while it is appropriate to laugh when you hear a joke), while social motives correspond to the reasons why we do or do not express a certain emotion in a specific situation (e.g. if you hear a bad joke from a friend you might laugh for prosocial motivation, that is, not to hurt their feelings; if you hear the same bad joke from your boss, you might laugh because you don't want your boss to think ill of you, in which case personal gain and protection is motivating you). In order to assess the impact of these two variables on emotional experience and Illusion of Transparency, different studies have been elaborated. In one study people were listening to bad jokes told by either friends or strangers in a competitive *vs* non-competitive situation. In another, parents of young children discussed about topics related to their child that worried them at the same or different level. In these studies, the appropriateness of expressing either amusement (first study) or worry (second study), and the reasons why one would want to express such emotions in the two situations described above have been tested. Results from these two studies have not been analysed yet, but the prediction is that expressing an emotion that participants do not feel will enhance Illusion of Transparency, especially when dealing with strangers in a non-competitive situation, and that in dealing with someone we share a close relationship with, such phenomenon should diminish to a minimum, especially when neither partner is trying to express more or less worry in order to calm the other or make them taking a certain issue more seriously.

Overall, Claudia Marinetti's thesis will contribute to a deeper understanding of emotional interactions, taking into account the influence of both socio-cultural and cognitive variables on explicit and implicit responses to emotional events. This should also provide systems developers with better knowledge about the existence of different modes of interpersonal response to emotions, which in turn would support them in programming embodied agents that can appropriately engage emotionally during an interaction.

3.2 Internal communication

It has been noted that WP3 had the role of providing psychologically-driven inputs to more engineering-oriented groups. As a result, WP3 had a unique role in both in organising HUMAINE events and in providing one-on-one support.

Achievement 4: First HUMAINE Workshop, Geneva June 17-19, 2004

WP3 held the first HUMAINE workshop on June 17-19, 2004, entitled "Theories and Models of Emotion". 65 researchers from different research fields took part in promising, enthusiastic and very stimulating discussions.

The aim of the workshop was to bridge gaps between disciplines such as Psychology, Cognitive Neuroscience, Philosophy, Ethology, and Computer Science by attempting to create a cohesive Affective Science research community. The format we chose was largely based on interactions between people, introducing a question-answer process to stimulate cognitive appetites.

Friday, June 18, 2004, was our first day of debate. The morning session was the chance for Computer Scientists to explain, in detail, their research goals by introducing the audience to live demonstrations of their systems. This session covered a number of important topics of discussion and drew the curiosity of the non-Computer Scientists. The afternoon had a didactic function as talks were given on the possible outcomes of each discipline represented in the study of emotions, namely Psychology, Cognitive Neuroscience, Robotics, and Neural Networks.

Saturday was our last day of discussions. The morning session was divided into 3 different "work groups". The explicit goal was to explore and define the possible outcomes of the WP3. During this "getting-our-hands-dirty" part of the day, the work groups detailed a course of action for the next several years and the deliverables of WP3. Synthesis and talks concluded the workshop.

Achievement 5 “Autumn Academies in Affective Sciences”

Training for young researchers was a fundamental part of HUMAINE’s brief, and summer schools were envisaged as a key medium. Psychological training was particularly important in an organisation where most members came from an engineering background, and WP3 therefore had a particularly high profile in the organisation of Summer Schools (or Autumn Academies, as they were sometimes more accurately called).

The second HUMAINE Summer School, in 1995, was organised by WP3 and held in Geneva. WP3 also had a major input to the third HUMAINE Summer School, in 1996, held in Genoa. Reports on the Summer Schools are in deliverables D1e and D1h respectively.

Achievement 6 The Haifa workshop on conceptualising emotion

Terminological and conceptual clarification proved a difficult challenge, even at the basic level of stating what HUMINE was about. In the Technical Annex, the term “emotion-

oriented systems” was to describe the domain. Others have used the term “affective computing” to mean almost the same thing. The difficulty is that ‘emotion’, ‘affect’, and all the other related terms (‘feeling’, ‘expression’ and so on) are semantically volatile: they take on quite substantially different meanings in different contexts.

It became clear in the course of the project that although the issue was essentially semantic, it could cause real difficulty. To achieve the best possible resolution, a meeting sponsored by HUMAINE at the University of Haifa in May 2007 brought together group of highly regarded philosophers, psychologists, neuroscientists, and experts in emotion-oriented / affective computing. They agreed the formulation given below (the ‘declaration of Haifa’).

Information technology has been increasingly concerned with a domain that seems intuitively to be important, but which is difficult to describe explicitly. The group regarded the following as a reasonable way to summarise the domain.

It incorporates the aspects of life that are not pure cognition, appetite or will, including emotions, moods, stances, bonds, and altered states of control, arousal and engagement.

These aspects involve units on several levels, episodic, enduring, and pervasive; and these involve some or all of the following components

- Global feelings and emotional colouring,
 - represented in terms of affective dimensions or appraisals;
- Distinctive action tendencies, modes of cognition & expression;
- Distinctive kinds of impression of relevant people, self & others;
- Rich connections to events and people past, present and foreseen

There are distinctive everyday terms to label some of them, but not all.

A summary that reflects a large part of this is ‘felt appraisals, states, connections, expressions and tendencies’. The domain is intimately linked to values and moral judgment. It is dependent on development and culture, and related phenomena are found in other species. It is more or less what Hume meant by ‘the heart’.

The declaration takes account of technical discussions in a variety of literatures: many of the relevant sources are considered HUMAINE deliverable D3i (Emotional life: Terminological and conceptual clarifications). Its primary function, though, is to provide a statement that non-experts can be referred to, so that they are not trapped by the vagaries of everyday language into basic misunderstandings about what research in the field does.

Achievement 7 One on one interactions

In March 2006, reviewers asked that the influence of WP3 on other areas should be made more visible. We prepared a response covering influences during 2005 and 2006. The exercise was not extended into 2007, but the record here indicates how extensive WP3 inputs were.

The aim is to document of the most salient features of HUMAINE, that is, the extent to which partners with a background in the theory of emotion have been involved in developments throughout the project. The result is that the emerging community has been thoroughly permeated by theoretical approaches to the subject.

- Work done on recognition in EmoTV and GEMEP videos allows for automatic gesture annotation. The annotation can be based on the emotion model of our choice depending on the desired level of detail since different emotion theories focus on different levels, dealing with phenomena of lower or higher orders.
- Imperial developed a computational model for forgiveness to be integrated in reputation systems (January 2006). Two papers have been already published in the iTrust conference series, one in 2005 and one in 2006. Imperial planned and executed an experiment to validate the need for integrating forgiveness into reputation systems (November 2006). The data is currently being analyzed. Imperial designed and developed mechanisms for increasing online self-awareness during norm violations. The mechanisms were validated in a trust experiment (March 2006). Imperial co-organised the workshop (with UCL) 'Reinventing trust collaboration and compliance in social systems' at CHI 2006. One of the aims of the workshop was to highlight the role of emotions in computer-mediated communication. The work on forgiveness and self-awareness was presented at the HUMAINE Plenary.
- USC and UNIGE-GERG collaborated with a view to understanding the relationship between appraisal theories of emotion (specifically sequential checking theory), and computational models. Output of these discussions will appear as a chapter in a proposed book. USC also co-organized, with Paolo Petta (WP7), an international workshop on modeling the cognitive antecedents and consequences of emotion in Vienna, April 2006. This workshop was directed at bridging theoretical and computational approaches to emotion. USC also organized a HUMAINE-sponsored invited talk by Brian Parkinson of UOXF at the International Conference of Intelligent Virtual Agents, August 2006.
- USC collaborated with WP6 HUMAINE partners (Paris8, Twente) and external collaborators on development of the Behavior Markup Language (BML) to represent emotional and other nonverbal behaviours for the purpose of animating interactive agents.
- Paris8 continued working on expressive behaviours using the GEMEP database (provided by the University of Geneva). A small number of videos has been selected. The videos were annotated at different levels: segmentation of gestures into phases as described by McNeill, and description of the gesture shape and of the expressivity parameters for each gesture phase. In a parallel collaboration with DIST of University of Genoa, automatic extraction of the expressivity parameters over the same videos was implemented. Then the manual annotations as well as the automatic extraction of the parameters of the videos were input to the Greta system that renders the ECA animation. Thus the animation of the ECA was obtained directly from behaviour description, not from a high-level description (such as APMML tags) as was done previously. This new way of controlling the agent allows us to automate the flow – from annotation/analysis to synthesis. This work is being done jointly with WP6.
- Preliminary work on synthesis of facial expressions based on the component process model predictions gave rise to various interesting questions regarding the eliciting situations and how these can be controlled in the case of a virtual environment. The manner in which the expression evolves through time based on the CPM predictions will be investigated more thoroughly in future work.

- DFKI advocated the use of concepts from emotion theory in the discussions in the W3C Emotion Incubator group, thus contributing to the dissemination activities within WP3.
- UNIGE-GERG presented a Humaine-“funded” paper on GEMEP - GENEVA Multimodal Emotion Portrayals - to the workshop on “Corpora for Research on Emotion and Affect”, at LREC 2006, Genoa.
- In November 2006, two ratings studies were carried out in Geneva as a contribution to the CEICES initiative. Detailed descriptions and results of this work are reported in the Humaine deliverable D3g.
- Members of UNIGE-GERG collaborated with A. Vassalou (Imperial College) on a “Think Aloud” paradigm. A. Vassalou presented preliminary results at the WP10 workshop in Vienna, Austria, and a perception study on the material recorder was carried out in December 2006.
- In response to developing interest in gesture (for instance through the Gesticon group), a workshop on emotional gestures was organized in Geneva. (the workshop took place in January 2007).
- We note the collaboration that took place between Swiss Centre for Affective Sciences, GERG and HUMAINE at a workshop on "Virtual Emotions" organized by the Swiss House in Singapore, bringing together researchers from two HUMAINE projects in Geneva - GERG and MiraLab (N. Thalmann) - and leading scholars in this area from the National University of Singapore and Nanyang Technological University.
- ICCS and EPFL worked together in creating an ontology which supports the modelling of emotional facial animation in virtual humans. Expression profiles can be defined using different models of emotion (dimensional, discrete etc). This work aims to help solve the knowledge representation issue of virtual agents' affective states. It can easily be extended and thus allows for flexibility depending on the problem at hand and the model adopted. The ontology can use real data as input.

3.3 Publication

It has been noted that WP3 had the role of providing psychologically-driven inputs to more engineering-oriented groups. As a result, WP3 had a unique role in both in organising HUMAINE events and in providing one-on-one support.

Achievement 8: The first ‘High Quality Public Deliverable’

HUMAINE was asked during 2004 to produce a ‘high quality public deliverable’. The first was provided by WP3 members, on the basis of work done in preparation for HUMAINE and its first year.

J.G. Taylor, K. Scherer & R. Cowie (eds) *Emotion and Brain: Special issue of Neural Networks* vol 18 no 4, May 2005

HUMAINE members authored or coauthored all of the articles.

Achievement 9: Contributions to HUMAINE Handbook

WP3 has played an important role in the development of the HUMAINE Handbook, including participation in the writing of many of the chapters. This volume is intended to be a lasting legacy of the project. A preliminary outline of it has now been agreed, as planned, and authors have been identified. WP3 was responsible for the first section of the book, “Theory and Models”, but had involvement and a consultative role in many of the others. The WP3 section and chapter headings are listed below. The book is to be published in 2008.

Theory and Models

1. Conceptual Clarifications, General - A. Ben-Ze'ev, HU; R. Cowie, QUB; B. Parkinson, UOXF
2. Conceptual Clarifications - an Integrative Approach - K. Scherer, UNIGE
3. The Bridging Function of Affective Neuroscience - D. Grandjean, D. Sander, K. Scherer, UNIGE
4. Psychological Models of Emotional Expression - A. Batliner, FAU Erlangen; T. Bänziger, S. Kaiser, UNIGE
5. A Computational Approach to the Component Process Model of Emotion - E. Roesch, K. Scherer, UNIGE, J. Taylor, KCL.

Achievement 10: “Blueprint” volume

The central aims of Work Package 3 were defined as follows:

- Exploring emotions: being highly cross-disciplinary, WP3 aims at defining and studying emotions using available expertise. In this framework, disciplines will constrain one another, and this recurrent feedback will provide new ways of addressing emotions.
- Feeding the network: WP3 is considered a content-oriented Work Package, in that its general mission is to support other Work Packages by providing the engineering-oriented community with comments, critics and synthesis of the work already available in the Humanities.

Work Group 2 of WP3 (“Emotion models and computational modelling”) had as its main goal to provide the community with formal descriptions of the mechanisms involved in emotional processing. It gathered the different points of view taken from contemporary theory, including Psychology, Cognitive Neuroscience, Philosophy, Ethology, and Computer Science, and aimed at creating a fruitful dialog with engineering-oriented groups regarding issues encountered during the implementation process of the theories. The main enterprise of WG2 took the form of an edited book “A blueprint for an affectively competent agent”. It is described below.

A blueprint for an affectively competent agent: Cross-fertilization between Emotion Psychology, Affective Neuroscience, Philosophy, and Affective Computing

Editors: Tanja Bänziger, University of Geneva, Klaus R. Scherer, University of Geneva

This volume is proposed as a source book and manual for all those interested in computational models of emotion based on the state of the art in current scientific investigation of affect in Emotion Psychology and Affective Neuroscience. Its aim is to present systematic theoretical conceptualizations of the processes underlying emotional reactions and their implications for various fields in applied Affective Computing.

The focus of the core contributions is an accessible description of the structures, functions, and mechanisms underlying emotional reactions; including processes involved in the elicitation of emotional responses, as well as expressive and physiological responses generated during emotional responses, and interpersonal perception of emotional responses.

The book takes the form of a dialogue between conceptualizations and propositions grounded in Emotion Psychology, in Affective Neuroscience, in Philosophy and in several areas of Affective Computing. Its overarching goal is to outline how the perspectives of those different disciplines can inform each other and how this cross-fertilization can give rise to new perspectives and questions in the research fields considered.

The book is organised in five sections. The first, introductory, section sets the groundwork for the volume and emphasizes the need to relate theoretical propositions as well as empirical data gathered in psychological and in neuropsychological studies to operating models used in affective computing. It illustrates, using selected examples, how psychological models and theories dealing with emotional responses might, in principle, benefit from being "translated" (operationalized) into computational terms. Reciprocally, it also outlines the purported benefits for computational models to integrate theoretical propositions and empirical results from other disciplines.

The second section presents the state of the art in current scientific investigation of affect in Emotion Psychology and/or Affective Neuroscience. The individual contributions (chapters) in this section are articulated around different components of emotional responses (e.g. processes involved in the elicitation of emotional reactions; physiological reactions involved in emotional responses; expressive behaviour and interpersonal communication in emotional episodes). Each chapter in this section includes several proposals regarding the theories (models) and/or the

empirical knowledge that might be usefully applied to affective computing. Such proposals might include suggestions to test specific predictions made in the respective fields using computational models (or expressive embodied agents), as well as suggestions aiming at improving operating models in affective computing (i.e. enhancing the "affective competence" of computers on the basis of models and/or data available in the respective fields).

The third section outlines a philosophical perspective on emotional feeling and emphasizes the importance of this perspective for the design of an affectively competent agent.

The fourth section introduces the perspectives of several applied domains in engineering and computer sciences on emotional reactions and their conceptualization in the respective fields. Individual contributions (chapters) in this section are articulated around different applications (e.g. expression of emotion in embodied conversational agents, neural network models of emotional processes). Each chapter in this section addresses one or more proposition(s) raised in section 2 and/or in section 3 and discusses its feasibility with respect to the state of the art in the respective applied field. Each chapter also, on a more general level, outlines its own perspective on the possibilities and the limitations of the current technologies and methods available in engineering and computer sciences to address and/or incorporate the models and paradigms developed by psychologists and neuroscientists, or the propositions formulated by philosophers, for the study of emotional reactions.

The fifth, concluding, section attempts to integrate some of the views presented in the chapters of the earlier sections and raises tentative proposals regarding the possibilities of enhancing cross-fertilization across disciplines with respect to the study of emotions in humans and in machines. Based on the contributions of the earlier sections, the last section also includes tentative conclusions regarding the minimal characteristics (specifications) of an "affectively competent agent" and tentative predictions regarding the prospect of such an agent in the near and distant future.

The book proposal was submitted to Oxford University Press in February 2007. The publisher's subsequent evaluation of the project has been favourable, and the book is expected to appear in 2008.

4 WP3 Deliverables (all of these are available on the portal)

Del. no	Deliverable name
D3a	Workshop proceedings: Theory
D3b	Proposal for methods toolbox
D3c	Preliminary Plans for Exemplars - Theory
D3d	Potential exemplars: theory
D3e	Proposal for exemplar and work towards it: Theory
D3f	Semantic space of affect labels across languages
D3g	Rating studies in CEICES project
D3h	Response patterning section of blueprint
D3i	Emotional life: Terminological and conceptual clarifications
D3j	Actuarial occurrence of affective phenomena
D3k	Pre-completion report on Blueprint Volume